

Chapter 8

QUANTIFYING THE IMPACTS OF REGULATORY REFORM IN INFRASTRUCTURE ON ECONOMIC PERFORMANCE IN APEC ECONOMIES

*Marn-Heong Wong*¹

- Foreign direct investment inflows at the aggregate level are influenced by the general regulatory environment in an economy rather than by regulation which is specific to infrastructure.
- There is some evidence of the positive influence of infrastructure regulatory quality when examining flows at the sectoral level, at least for telecommunications.
- Quality of regulation includes aspects other than just the independence of the regulator.

8.1 INTRODUCTION

Policy debate on the impact of structural reform often makes use of a series of indicators of institutional quality and of the characteristics of an economy's regulatory system. Such indicators are often produced by agencies such as the World Bank. APEC also uses similar indicators in its work programs on structural reform. In this chapter, indicators of this type are tested for their influence on indicators of economic performance. The focus is the link between regulatory quality and performance in relation to the infrastructure sector from two perspectives. The first explores how the quality of regulations, including infrastructure regulation, may affect foreign direct investment (FDI) in infrastructure industries. The second assesses how the regulatory environment may affect total FDI inflows.

The review finds that FDI inflows aggregated across infrastructure industries are influenced by the general regulatory environment in an economy, such as the legal framework and the cost of compliance with administrative requirements. This effect is more important than that of the quality of regulation. However, there is some evidence of a positive link between regulatory quality in a specific infrastructure sector and investments in that particular sector, such as in telecommunications.

For economy-wide total FDI inflows, more important are the opportunities for foreign investors to acquire a controlling share in domestic companies and the degree of openness to trade. Ease of access to finance also appears to be connected to the total FDI inflows.

APEC membership since 2004, when the structural reform agenda was launched, does not seem to be significantly associated with a higher rate of FDI inflows, after accounting for the regulatory environment, as well as other economy characteristics.

¹ Lee Kuan Yew School of Public Policy, National University of Singapore (sppwmh@nus.edu.sg).

These results focus only on one performance indicator but they suggest the value of further work using a longer time frame and testing a wider range of indicators of regulatory quality as they apply to infrastructure sectors. At the same time, they stress the importance of the general regulatory environment, at least for FDI.

8.2 MODELLING AND DATA

The paper estimates two models using panel data. The first relates regulation with FDI in infrastructure and is adapted from the specification in Kirkpatrick et al. (2006):

$$\text{InfraFDI}_{it} = \beta_0 + \beta_1 \text{REG}_{it} + \beta_2 X_{it} + \beta_3 \text{apect}_{it} + v_i + u_t + \varepsilon_{it} \quad [1]$$

where i denotes economy, t denotes year. The dependent variable, InfraFDI, is private foreign investment in infrastructure projects and measured in logarithm. REG refers to general regulatory and infrastructure policy variables and X represents the control variables, which will be elaborated below. *apect* is an interaction term to assess whether an economy that is an APEC member would receive higher private investments in infrastructure industries after 2004, as APEC members implement structural economic reforms that would fit within the APEC Leader's Agenda to Implement Structural Reform (LAISR). v_i absorbs the time-invariant economy-specific effects, while u_t is a set of year dummies to control for macroeconomic shocks; ε is the idiosyncratic error term.

The second model estimates the relationship between the regulatory environment and quality of infrastructure on aggregate FDI inflows to an economy:

$$\text{FDI}_{it} = \beta_0 + \beta_1 \text{REG}_{it} + \beta_2 X_{it} + \beta_3 \text{apect}_{it} + v_i + u_t + \varepsilon_{it} \quad [2]$$

FDI is measured as foreign direct investment inflow as a percentage of GDP. The right hand variables are the same as defined for Equation (1).

The data on FDI in infrastructure projects is obtained from the Private Participation in Infrastructure (PPI) Project Database compiled by the World Bank. The PPI data records infrastructure projects with private participation in the energy, telecommunications, transport, and water and sewerage sectors in low- and middle-income economies. Thus, the equation is estimated for a set of developing economies only, of which 11 are APEC member economies.

Detailed project information is examined to calculate private investors' share of investment commitments in infrastructure projects with private participation. State-owned enterprises or their subsidiaries are considered private investors in projects located offshore. Kirkpatrick et al. (2006) notes that about 80% of private contribution in infrastructure projects comes from foreign investors. Thus, the values of private investment can be regarded as comprising mainly values of private foreign investment and will reflect the influences of FDI determinants.

Regulatory quality variables are the focus of research interest in this chapter. Alternative sets of regulatory indicators are used, which comprise a mix of indicators of various aspects of the general regulatory environment as well as measures of infrastructure policy. General regulatory indicators are obtained from the alternative sources of the World Bank's Worldwide Governance Indicators (WGI) database produced by Kaufmann et al. (2009), IMD Business School's *World Competitiveness Yearbook* (WCY), and the World Economic Forum's *Global Competitiveness Report* (GCR). These regulatory indicators are based on survey responses and thus are subjective measures. They are also open to the criticism that they only give an idea of relative regulatory quality across economies in broad aspects but do

not provide information on the policy measures that might have contributed to an economy's ranking or changes in its relative position. Nevertheless, information from these sources has the advantage of containing annually updated data for a large number of economies and thus is suited for use in multiple-year, cross-economy regressions.

Where possible, a set of indicators is chosen to proxy for the five priority areas of the LAISR, namely: regulatory reform, strengthening economic legal infrastructure, competition policy, corporate governance and public sector management. However, it is noted that some of these indicators may be highly correlated as they reflect the common underlying governance and policy environment of an economy. Thus, the final set of regulatory indicators included in any estimation is selected after checking their degree of correlation and also using the best fitting specification based on a model selection criterion (this is called the Akaike Information Criterion).

The effective regulation of privatised infrastructure sectors requires a policy environment that sustains market incentives and investor confidence, and a key condition towards this end is independence of the regulators from political interference. Following Kirkpatrick et al. (2006), this study constructs a dummy variable that takes a value of 1 if an economy has independent regulators in both the telecommunications and electric power industries in any year, to proxy for the quality of its infrastructure regulation. 'Independence' here refers to organisational independence of the regulatory bodies – where the regulator is not integrated as a section of a government ministry – rather than their actual autonomy from government interference. This information is obtained from the International Energy Regulation Network and the International Telecommunications Union. A second measure used in the estimations that proxies for infrastructure policy is the survey response to the question of whether 'maintenance and development of infrastructure are adequately planned and financed' from WCY.

The scope of the set of variables measuring economy characteristics (called control variables) is based on the specification in Kirkpatrick et al. (2006) and data obtained from the World Bank's World Development Indicators database. These variables are:

- real GDP *per capita* as a measure of the level of income and demand in an economy;
- inflation, domestic credit, exchange rate and taxation variables to capture macroeconomic stability;
- trade openness; and
- domestic financial development and skills level of the labour force as indicators of structural characteristics of the host economy.

Not all the control variables in Kirkpatrick are used in the final estimations, as the inclusion of all the variables significantly reduces the sample size and the excluded variables are found in preliminary estimations to be statistically insignificant. The final set of control variables included are lagged variables of income *per capita*, inflation and openness to allow for statistical problems (including potential endogeneity bias and adjustment lags).

The apec-time (*apect*) interaction term is constructed as $a_{it} \times tr_t$, where a_{it} is a dummy that is 1 if an economy is an APEC member in year t and 0 otherwise, and tr_t is a trend term with 0 values before 2004.

The main regression technique applied in the estimations is fixed effects panel regression, which controls for time-invariant, economy-specific effects. However, since the dataset is a relatively short panel that covers 2000 to 2008 (or shorter depending on the set of regulatory

indicators used), the equation is also estimated using pooled OLS with cluster-robust standard errors, on the assumption that the errors are correlated over time for each economy but not across economies.

8.3 RESULTS AND ANALYSIS

Table 8.1 presents the results for the pooled OLS and fixed effects regressions with FDI in infrastructure projects as the dependent variable. The results apply to a set of developing economies for which data are available and include the APEC economies of Chile; China; Indonesia; Malaysia; Mexico; Peru; the Philippines; the Russian Federation; Thailand; and Viet Nam.

Of the regulatory and infrastructure policy variables there is evidence of a statistically significant and positive relationship between the quality of a general regulatory environment and foreign private investment in infrastructure across the different sets of regulatory indicators used.² Coefficient estimates that are significant include those on the WGI-government effectiveness index, the WCY indicator on whether a ‘legal and regulatory framework encourages the competitiveness of enterprises’ and the GCR indicator on whether ‘complying with administrative requirements is burdensome’.

The correlation between infrastructure policy and quality and FDI in infrastructure is generally insignificant. In particular, the dummy of regulatory independence is not significant across all specifications. The *apec-time* interaction term intended to capture the differential effects of regulatory changes since 2004 in APEC economies is only sometimes significant.

Table 8.2 reports the results of pooled OLS and fixed effects regressions with economy-level FDI inflows as the dependent variable. The sample used for the aggregate FDI equations includes a much larger number of economies than the sample for the FDI in infrastructure equations. These economies are spread across different income levels and comprise all APEC economies except Brunei; Papua New Guinea; and Chinese Taipei where not all the data included in the regressions are available. The regulatory and infrastructure policy variables are largely insignificant regardless of the sets of regulatory indicators and econometric methods used. The only exception is the WCY variable on whether ‘foreign investors can acquire control in domestic companies’, which is significant and positive. The variable that is consistent in being strongly and positively correlated with FDI across regressions is trade as a percentage of GDP. The last two findings indicate that FDI is encouraged by economies that are more open to trade and that foreign investors respond to lower restrictions on FDI. There is also evidence that an increase in credit extended to the private sector, which proxies for ease of access to finance, is associated with higher FDI. The *apec-time* interaction term is significant only in pooled OLS regressions and is negatively signed across specifications.

The dummy variable that measures regulatory independence in infrastructure (precisely, in both telecommunications and electricity industries) is found to be insignificant across the board, regardless of whether the dependent variable is infrastructure investments or aggregate FDI inflows. This is unlike the findings in Kirkpatrick et al. (2006), where the variable is weakly significant (at the 10% level) and positively correlated with infrastructure investment in selected specifications. As mentioned in Kirkpatrick et al. (2006), when both general regulatory indicators and an infrastructure regulatory independence dummy are included in

² All mentions of ‘significance’ in this section refer to statistical significance.

Table 8.1: Results for the pooled OLS and fixed effects regressions with FDI in infrastructure projects as the dependent variable.

Dependent variable: Ln FDI in Infrastructure	(1)	(2)	(3)	(4)	(5)	(6)
Economy fixed effects	No	Yes	No	Yes	No	Yes
Regulatory environment						
<u>WGI</u>						
Government effectiveness index	0.064 (0.885)	1.850 (0.462)***				
<u>WCY</u>						
Control by foreign investors			-0.236 (0.128)*	0.102 (0.085)		
Legal and regulatory framework			0.301 (0.134)**	0.388 (0.100)***		
Shareholders' rights			-0.120 (0.238)	-0.089 (0.127)		
<u>GCR</u>						
Business impact of rules on FDI					-0.374 (0.323)	0.329 (0.202)
Burden of government regulation					-0.070 (0.271)	0.370 (0.187)**
Effectiveness of anti-monopoly policy					1.237 (0.420)***	0.027 (0.244)
Protection of minority shareholders' interests					-0.202 (0.358)	-0.338 (0.213)
Infrastructure policy						
Independence of regulators in electric power and telecommunications sectors (dummy variable)	-0.405 (0.260)	-0.017 (0.222)	0.197 (0.376)	-0.112 (0.290)	0.129 (0.440)	-0.159 (0.311)
Maintenance and Development of infrastructure (WCY)			-0.089 (0.139)	-0.270 (0.124)**		
Control variables						
Ln GDP per capita (lagged)	0.604 (0.235)**	-1.174 (1.046)	0.129 (0.228)	1.977 (1.126)*	0.175 (0.250)	-1.304 (1.618)
Annual change of inflation (lagged)	0.002 (0.007)	-0.014 (0.005)***	-0.028 (0.015)*	-0.018 (0.010)*	0.015 (0.020)	-0.014 (0.014)
Export and import/GDP (lagged)	-0.021 (0.005)***	-0.001 (0.007)	-0.013 (0.005)**	-0.020 (0.009)**	-0.018 (0.006)***	0.007 (0.010)
Domestic credit to private sector/GDP	0.017 (0.006)***	0.016 (0.006)**	-0.002 (0.004)	0.015 (0.005)***	0.005 (0.007)	0.014 (0.007)*
apec-time interaction term	0.305 (0.108)***	-0.181 (0.064)***	0.112 (0.094)	-0.155 (0.089)*	0.405 (0.113)***	-0.038 (0.089)
Joint significance of year dummies (p-value)	0.002	0.000	0.008	0.121	0.260	0.006
Adjusted R2	0.365	0.813	0.253	0.776	0.376	0.844
No. of observations	440	440	150	150	243	243
No. of economies	62	62	23	23	54	54

Standard errors in parentheses.

***, **, * - indicates significance at the 1, 5 and 10% levels

the same regression, results of significant coefficients on the former and insignificant coefficient on the latter could indicate that investors, whether in infrastructure or more generally, are more strongly influenced by the overall governance environment, and infrastructure regulation does not exert an independent influence from the quality of overall governance.

Table 8.2: Results for the pooled OLS and fixed effects regressions with economy-level FDI inflows as the dependent variable.

Dependent variable: FDI	(1)	(2)	(3)	(4)	(5)	(6)
Economy fixed effects	No	Yes	No	Yes	No	Yes
Regulatory environment						
<u>WGI</u>						
Government effectiveness index	0.674 (0.491)	1.398 (1.321)				
<u>WCY</u>						
Control by foreign investors			1.015 (0.270)***	0.743 (0.443)*		
Legal and regulatory framework			0.369 (0.306)	-0.134 (0.411)		
Shareholders' rights			-0.498 (0.376)	-0.429 (0.561)		
<u>GCR</u>						
Business impact of rules on FDI					0.499 (0.845)	0.052 (0.915)
Burden of government regulation					0.321 (0.711)	0.222 (0.682)
Effectiveness of anti-monopoly policy					0.168 (0.637)	-0.110 (0.918)
Protection of minority shareholders' interests					-0.872 (0.707)	-0.894 (0.917)
Infrastructure policy and quality						
Independence of regulators in electric power and telecommunications sectors (dummy variable)	-0.253 (0.495)	0.269 (0.700)	-0.330 (0.551)	-0.356 (1.265)	-0.518 (0.865)	-0.699 (1.374)
Maintenance and Development of infrastructure (WCY)			-0.058 (0.273)	0.540 (0.532)		
Control variables						
Ln GDP per capita (lagged)	-0.247 (0.307)	2.814 (3.316)	-0.503 (0.388)	-2.323 (5.325)	-0.091 (0.263)	-6.497 (7.031)
Annual change of inflation (lagged)	0.031 (0.019)*	0.048 (0.018)***	-0.031 (0.028)	-0.022 (0.061)	0.025 (0.040)	0.031 (0.064)
Export and import/GDP (lagged)	0.044 (0.006)***	0.088 (0.017)***	0.037 (0.006)***	0.107 (0.022)***	0.045 (0.008)***	0.062 (0.032)*
Domestic credit to private sector/GDP	-0.005 (0.008)	0.027 (0.014)*	-0.007 (0.008)	-0.021 (0.023)	0.004 (0.011)	0.085 (0.026)***
apec-time interaction term	-0.525 (0.254)**	-0.187 (0.242)	-0.354 (0.268)	-0.179 (0.326)	-0.634 (0.281)**	-0.339 (0.408)
Joint significance of year dummies (p-value)	0.0006	0.7321	0.0015	0.3097	0.0026	0.0865
Adjusted R2	0.318	0.472	0.419	0.541	0.317	0.632
No. of observations	660	660	323	323	331	331
No. of economies	99	99	51	51	89	89

Standard errors in parentheses.

****, **, * - indicates significance at the 1, 5 and 10% levels*

Some studies (e.g., Cubbin & Stern 2006; Zhang et al. 2008) have found a significant and positive link between the quality of regulation of the electricity industry, which included regulatory independence, and a positive outcome as measured by generation capacity. So it may be the case that independence of the regulator in an infrastructure sector might be more specifically linked to outcomes in that sector. To test this premise, two additional regressions

are conducted in this paper. The first relates private investment in telecommunications infrastructure projects (which accounts for over half the amount of infrastructure investments) to independence of telecom regulators only. The other relates private investment in energy infrastructure projects (which accounts for 28% of total investments) to independence of electricity regulators only. The other variables remain as specified in Equation (1).

The results are reported in Tables 8.3 and 8.4. It is observed that the regulatory dummy variable is now significant in a number of regressions although not always with the expected signage. Independence of telecom regulators is strongly and positively related to FDI in telecoms infrastructure projects in developing economies when fixed effects regression is run on the sample that includes GCR indicators. However, the variable is weakly significant and negative in the sample using WCY indicators. Coefficient estimates on the electricity regulatory independence variable are significant in the sample with the WGI variable but they are negative.

8.4 CONCLUSION

The paper finds that FDI flows, whether aggregated across infrastructure industries or at the economy-wide level, are influenced by the general regulatory environment in an economy rather than regulation which is specific to infrastructure. There is no conclusive evidence that APEC membership since 2004 is significantly associated with a higher rate of FDI inflows. There is some evidence of the positive influence of infrastructure regulatory quality when examining flows at the sectoral level, at least for telecommunications. Further investigations could be carried out by constructing a regulatory indicator that takes into account more dimensions of infrastructure regulatory quality than the independence of regulators and using a longer time series. Overall the results, although mixed, serve to highlight that the quality of infrastructure regulations should be taken into consideration in any statistical analysis of infrastructure sector performance.

Table 8.3: Relating private investment in telecommunications infrastructure projects to independence of telecom regulators.

Dependent variable: Ln FDI in Telecom Infrastructure	(1)	(2)	(3)	(4)	(5)	(6)
Economy fixed effects	No	Yes	No	Yes	No	Yes
Regulatory environment						
<u>WGI</u>						
Government effectiveness index	-0.142 (0.361)	0.353 (0.370)				
<u>WCY</u>						
Control by foreign investors			-0.176 (0.168)	0.122 (0.082)		
Legal and regulatory framework			0.215 (0.125)*	0.344 (0.095)***		
Shareholders' rights			-0.147 (0.280)	-0.116 (0.132)		
<u>GCR</u>						
Business impact of rules on FDI					-0.291 (0.283)	-0.001 (0.186)
Burden of government regulation					-0.376 (0.249)	0.116 (0.162)
Effectiveness of anti-monopoly policy					1.328 (0.342)***	0.198 (0.214)
Protection of minority shareholders' interests					-0.276 (0.343)	0.170 (0.196)
Infrastructure policy						
Independence of regulators in telecommunications sector (dummy variable)	0.426 (0.404)	-0.005 (0.291)	0.123 (0.492)	-0.576 (0.343)*	0.148 (0.553)	1.822 (0.667)***
Maintenance and Development of infrastructure (WCY)			-0.218 (0.154)	-0.293 (0.128)**		
Control variables						
Ln GDP per capita (lagged)	0.683 (0.171)***	-0.584 (0.790)	0.144 (0.241)	2.638 (1.264)**	0.166 (0.188)	-1.449 (1.538)**
Annual change of inflation (lagged)	0.010 (0.005)**	-0.013 (0.004)***	-0.031 (0.014)*	-0.032 (0.010)***	0.031 (0.021)	-0.008 (0.013)
Export and import/GDP (lagged)	-0.021 (0.004)***	0.004 (0.005)	-0.011 (0.007)	-0.010 (0.008)	-0.016 (0.006)***	0.003 (0.009)
Domestic credit to private sector/GDP	0.016 (0.006)***	0.002 (0.005)	-0.002 (0.005)	0.004 (0.005)**	0.006 (0.007)	0.002 (0.007)
apec-time interaction term	0.418 (0.109)***	-0.164 (0.067)**	0.136 (0.091)	-0.020 (0.063)*	0.375 (0.102)***	-0.036 (0.089)
Joint significance of year dummies (p-value)	0.000	0.000	0.4885	0.3666	0.1143	0.025
R2	0.376	0.8260	0.237	0.811	0.394	0.846
No. of observations	559	559	145	145	272	272
No. of economies	92	92	23	23	64	64

Standard errors in parentheses.

****, **, * - indicates significance at the 1, 5 and 10% levels*

Table 8.4: Relating private investment in energy infrastructure projects to independence of electricity regulators.

Dependent variable: Ln FDI in Energy Infrastructure	(1)	(2)	(3)	(4)	(5)	(6)
Economy fixed effects	No	Yes	No	Yes	No	Yes
Regulatory environment						
<u>WGI</u>						
Government effectiveness index	0.090 (0.614)	0.651 (1.019)				
<u>WCY</u>						
Control by foreign investors			-0.407 (0.184)**	-0.405 (0.299)		
Legal and regulatory framework			0.227 (0.321)	0.359 (0.283)		
Shareholders' rights			0.061 (0.404)	0.262 (0.393)		
<u>GCR</u>						
Business impact of rules on FDI					-0.603 (0.459)	-0.684 (0.549)
Burden of government regulation					0.081 (0.436)	0.258 (0.486)
Effectiveness of anti-monopoly policy					0.950 (0.550)*	0.957 (0.637)
Protection of minority shareholders' interests					0.115 (0.526)	-0.655 (0.674))
Infrastructure policy						
Independence of regulators in electric power sector (dummy variable)	-0.828 (0.376)**	-1.219 (0.532)**	0.120 (0.556)	-1.344 (0.860)	0.347 (0.552)	1.034 (1.077)
Maintenance and Development of infrastructure (WCY)			-0.042 (0.340)	-0.079 (0.377)		
Control variables						
Ln GDP per capita (lagged)	0.234 (0.340)	3.271 (2.096)	-0.033 (0.365)	6.305 (3.274)*	-0.054 (0.290)	4.779 (4.606)
Annual change of inflation (lagged)	0.002 (0.011)	0.011 (0.017)	-0.005 (0.029)	0.027 (0.029)	0.005 (0.020)	-0.028 (0.057)
Export and import/GDP (lagged)	-0.007 (0.007)	-0.024 (0.017)	-0.003 (0.008)	-0.011 (0.027)	-0.001 (0.008)	-0.053 (0.033)
Domestic credit to private sector/GDP	0.007 (0.010)	0.009 (0.015)	-0.008 (0.017)	0.020 (0.021)	-0.009 (0.015)	0.044 (0.026)*
apec-time interaction term	0.187 (0.138)	-0.024 (0.124)	0.100 (0.145)	0.158 (0.180)	0.291 (0.123)**	0.248 (0.213)
Joint significance of year dummies (p-value)	0.0066	0.0875	0.2315	0.1583	0.0036	0.4298
Adjusted R2	0.115	0.454	0.050	0.448	0.134	0.498
No. of observations	237	237	119	119	137	137
No. of economies	58	58	22	22	43	43

Standard errors in parentheses.

***, **, * - indicates significance at the 1, 5 and 10% levels.

8.5 REFERENCES

- Cubbin, J & J Stern 2006. 'The Impact of Regulatory Governance and Privatization on Electricity Industry Generation Capacity in Developing Economies', *The World Bank Economic Review*, 20(1): 115–41.
- Kaufmann, D, A Kraay, & M Mastruzzi 2009. 'Governance Matters VIII: Aggregate and Individual Governance Indicators, 1996-2008', World Bank Policy Research Working Paper 4978, Washington, DC.
- Kirkpatrick, C, D Parker & Y-F Zhang 2006. 'Foreign Direct Investment in Infrastructure in Developing Countries: Does Regulation Make a Difference', *Transnational Corporations*, 15(1): 143–71.
- IMD Business School. *World Competitiveness Yearbook*. Various years.
- International Energy Regulation Network. http://www.iern.net/portal/page/portal/IERN_HOME.
- International Telecommunication Union. <http://www.itu.int/en/pages/default.aspx>.
- World Economic Forum. *The Global Competitiveness Report*. Various years. Palgrave McMillan. Switzerland.
- Zhang, Y-F, D Parker & C Kirkpatrick 2008. 'Electricity Sector Reform in Developing Countries: An Econometric Assessment of the Effects of Privatization, Competition and Regulation', *Journal of Regulatory Economics*, 33: 159–78.